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Inside . . .

The Importance of Planning Ahead

From the Editor . . .

We're living in interesting times. Technology has changed the way we work and see the world. Even since the turn of the 21st Century, changes have been phenomenal and are happening faster than we can absorb.

The construction industry is not immune. While there have been many developments in new materials, systems and technologies, we still rely on the experience and knowledge of designers, consultants and most importantly, the trades, to ensure that what we construct will perform.

In the distant past, knowledge was passed from generation to generation by on-site learning, as experienced craftsmen passed on their expertise. Innovation may have been slow, but it did happen through careful observation and cautious experimentation, with occasional bursts of sudden innovation.

But problems still came up, usually wherever there was a construction boom and the industry was pressured and too much was built too quickly. At those times there is a pressure to incorporate new technologies, often used by newcomers to the industry without experience or ability to assess the broader picture.

In the 20th Century, a more rigorous scientific analysis of construction came into being. Building science as a serious discipline began and we gained a better understanding of building physics. As problems arose, research was undertaken to help solve the problems and in the process, increase the depth of building science knowledge.

Perhaps the biggest change today is the widespread access to information through the Internet. This makes it easier to access a wealth of information at a moment's notice from anywhere. Where in the past it would take a couple of days to access information before a decision could be made, now it can happen instantly through our cell phones.

This can be a curse as much as a blessing, since the important contextual or source information may not always be readily available – there need to be filters to sort out the appropriate information. What may be appropriate in one situation may not be correct in another. The filters can be the user accessing the data, or for those without the depth of knowledge that may be required, someone with expertise such as consultant, building official, or technical representative. But there needs to be thought applied as to what the correct answer is for a given situation.

This is a challenge even for building codes and standards. They set out a minimum set of criteria, which have to be suitable everywhere, but there still has to be some interpretation about how they can or should be applied.

The problem arises when the authority having jurisdiction is unable to apply a rational review when applying general principles to a specific situations. It could be because they don't have the background in building science, or the confidence when reviewing what may be considered unconventional details. In addition, they often lack the support of superiors to be open rather than simply avoiding any risk whatsoever, which leads to an insistence to stick to tried and true ways of doing business, even if it's not correct and the codes, which are reactive, haven't caught up. It could also be purely personal biases – "don't confuse me with the facts" - somewhat like our current government.

An example of this happened recently in BC. A provincial Building Code Appeal Board ruled on the suitability of a specific detail. The board ruling was done with a supplementary third-party review of the issue (not a common practice) and indicated that the concept being appealed was acceptable and did conform to code requirements. They stated that there is sufficient information that demonstrated the point. Despite that ruling, the local official, without the depth of expertise, balked at accepting the ruling and still insisted on details that can affect the building's durability.

Richard Kadulski
Editor

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The Importance of Planning Ahead

Despite appearances to the contrary, we in the homebuilding sector often forget the importance of design and planning before we start anything on the ground. Although a lot of work is done with preparation, costing, and addressing regulatory issues, the number of unresolved issues is astounding. While it may not be possible to preplan and address every last detail, the construction process has much room for improvement.

In the distant past, buildings may have been built with only a simple sketch showing the overlook size and look of the building, and the details were left to the craftsmen on the site to execute. Today we do not build that way – with the high degree of specialization, the average tradesperson on site does not have the ability to be able to work out details on the fly.

When a new aircraft design is launched, every feature is carefully designed. An attempt is made to anticipate any possible condition that might be experienced by the craft at the design stage, and that is followed up with rigorous and careful commissioning before the craft is put into use.

Compare that to how we build buildings. They are also sophisticated structures, but we often slap them together, without careful review of the design, other than the general form and appearance of the building. Major items, like keeping the water and snow out, and having functioning mechanical systems that will keep the building conditioned and provide hot water when needed, are worked out reasonably well as construction proceeds.

Users are left to fend for themselves when they occupy the building, and often need to work out the kinks as they settle in. Few bother to push for proper systems design and commissioning simply because most people don't know what can be achieved.

Although the dwellings we build are sophisticated, they are still prototypes, each one unique. No two houses are identical, and even similar looking 'cookie cutter' designs in subdivisions, are different, as each is built in a slightly different location, different orientation, under different weather conditions, at different times. This is unlike factory-built products, where the kinks are worked out with the first few prototypes and are then produced in volume.

We'll never achieve the same degree of mass production – although factory built housing comes close – but there is much room for improvement. A key step is investing energy in preplanning the project. The green building programs such as LEED put much emphasis on the design charrette – a workshop that involves the project team at the design stage.

To be meaningful, the team at the table should include not only the traditional design team (architect/designer, structural and mechanical consultant, green building consultant or energy advisor) but the owner and members of the construction team – the contactor and key trades. A good charrette will benefit from having not just the 'suits' from the team members, but people who are active in the field that can provide a real world perspective. In a good charrette everyone will leave their personal biases outside the room and allow for a free-flowing exchange of ideas to take place, so that all options can be pursued. Although everyone's expertise is valued, no one should focus only on their own area of expertise.

While the design charrette can help fashion the design of larger projects, the exercise can be applied even to a small house. The design ideas may not be grandiose, but everyone pooling their ideas and expertise in a free flowing review can be beneficial to optimize the design and detailing, especially if everyone can understand the final objective – what the owner wants out of their project, the design and aesthetic considerations, what is really important (views, access, landscaping, etc,), the level of energy performance desired, how 'green' they want the house to be, etc. The exercise can also sort out conflicts between trades, and help work out trade-offs between different systems and features before everyone gets on the jobsite.

A lack of preplanning can lead to a multitude of problems. We present a few details we've seen in houses under construction, mostly in the Vancouver area. These reflect issues that are seen everywhere, and should serve as a reminder to all concerned.

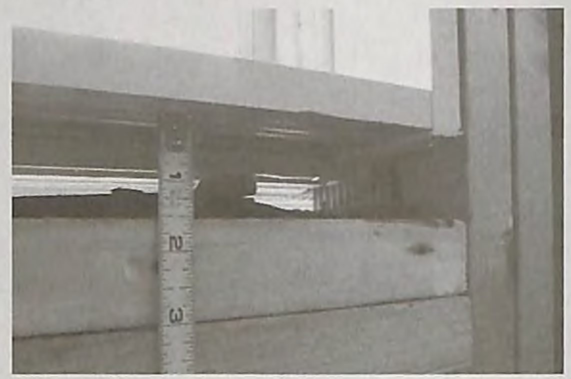
Problems can arise for many reasons. The builder or his trades may not even be aware that there is a problem. Sometimes, it's simply that no one thought through the consequences of a decision to do something, which creates problems in execution. At other times, it's using a good detail in the wrong location. It may be a lack of supervision, relying on the low bidder who doesn't have enough experience. It could be a builder relying on the building code to be the design guide, and the building inspector to be the quality control inspector, when neither is appropriate.

Too often, in our rush to get the job done, we jump in thinking it's a simple job, only to face a mass of problems that need to be worked out on site. We don't empower and value our trades to raise concerns and address them properly.

Windows

Wood framing allows us to make changes to window openings relatively easily. However, it is important that the window supplier and their required rough openings be known to the framers. The relationship of the windows to rooflines and other elements of the building should be easy to determine at the design stage, and should be clear on the plans. Unfortunately, it doesn't always happen, and late changes are made without consideration to the physical geometry of the building.

This is a case where the window size had to be changed, because there is a skirt roof outside the window that had not been considered at the time of framing so the windowsill had to be raised to maintain the required clearance to a sloping roof outside. Since the problem was noticed after the framing was up, the framers opted to simply reduce the opening by using lumber to reduce the opening size.



Because the window supplier rough opening size was not clearly identified, the rough opening ended up being much larger than required, creating problems for proper air sealing and finishing.

Mechanical System Layouts

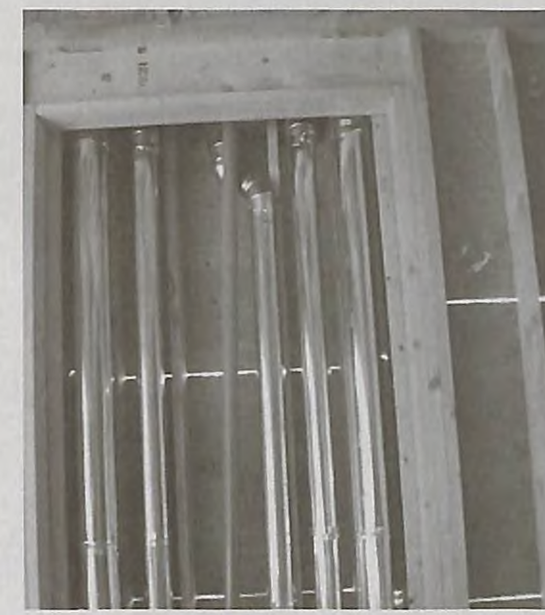
Mechanical system layouts, especially ducted systems, are perhaps the most commonly seen problems. Conflicts between ducts, plumbing, lighting and framing are constant. Owners and designers don't want to see drops to accommodate ducts, and the framing cannot always accommodate the required duct sizes.

In the past, when houses were chopped up into many rooms, there were opportunities to find ways to hide or camouflage drops and duct chases. Today's desire for open floor plans does not offer as many opportunities to deal with these.

A preconstruction design workshop/conference could go a long way to determine what the options are for the ducting system layout, to review a workable layout and minimize conflicts between structure, plumbing and design.

Ducts should always be kept inside the conditioned space of the house. Yet, it is not uncommon to see ducts in exterior walls. For insulation, 2" of Iso-board insulation (R-12) is typically installed on the exterior side of the ducts. However, there is the challenge of air sealing the duct, and maintaining the air seal around the duct penetration through the air barrier.

The new energy provisions of the code will require that ducts in the exterior must be insulated to no less than the value required for wall insulation, so the insulation provided by the rigid foam board will not be adequate.

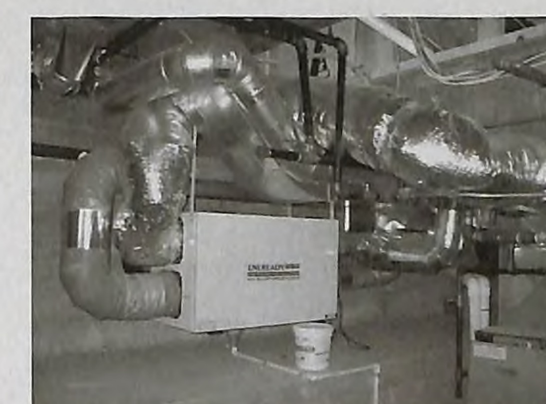


Ducts in an outside wall. Each one will penetrate the air barrier of the house, and will need to be air sealed.

Four ducts through ceiling poly air barrier. Construction tape is often used to seal layers of poly together, and this may work on seams in the poly, but the tape cannot properly seal a duct penetration. No matter how diligent the applicator is, it is difficult to apply a two dimensional tape in three dimensions.

Any penetration through the air barrier presents a challenge to maintain the air seal, as in this case, with the air sealing of the ducts that are outside the air barrier. Experience has shown us that ducts are quite leaky and a source of heat loss, unless special care is taken to air seal them. However, not many installers test the air tightness of their ductwork even though there is a protocol and equipment for it.

Ducts in an exterior wall with 2" iso-board insulation on the exterior side. Under new energy code requirements this will no longer be acceptable. Another challenge with this kind of detail is that the limited amount of space requires that the duct be rectangular, which could restrict airflow, especially as there could be tight elbow transitions at either end of the vertical duct. A shallow rectangular section of duct needs to be carefully sized in order to maintain the required airflows.



Heat recovery ventilators, by definition, bring in cold outside air and exhaust stale indoor air that has been cooled through the HRV. That means that at the HRV two of the ducts – the

fresh air supply and stale exhaust air from the house – must be insulated with a vapour barrier for the full length of the duct from the exterior to the HRV. Here is an installation that has got it only half-right: the fresh air duct is insulated, but not the stale exhaust duct.

Designing a duct layout before construction starts, even if it's only a general conceptual layout, would save a lot of grief later and achieve an efficient layout. In this example preplanning did not take place. The HRV is to be mounted in the garage at one end of a house that has a long skinny footprint. The ducts then need to snake along found spaces, adding length and resistance. Part of the layout is through a furred foundation wall placed in such a way that even a minimum amount of insulation on the ducts is not possible.

Placing the HRV in the garage is never a good idea because the garage is always outside the conditioned space of the house. The HRV itself and the ducts in the garage are seldom completely air tight, so there is the potential for gases to be drawn into the house, compromising the indoor air quality.

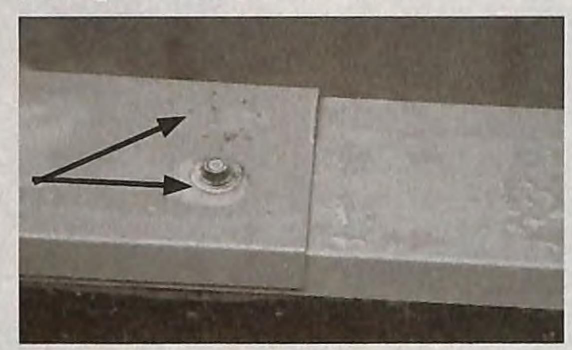
Flashings

Flashings are a seemingly minor but all-important element in building detailing. Their purpose is to divert water away from the building surface. When installed properly, they provide protection from water penetration into building assemblies; when installed poorly, they can become water injection devices into building assemblies.

Some of the most severe failures happen due to poor installation details and not understanding what is trying to be achieved through the detail. While some tolerances can be endured in some locations in the assembly, there are some critical points where care must be taken to do it properly.

Metal flashings are typically used at horizontal joints and material transitions to shed water away from building surfaces. Manuals such as CMHC's Best Practice guides, building codes and other technical documents stress their importance, but do not provide specific requirements for the flashing design.

It is amazing how much trust roofers place in caulking materials. There seems to be a belief in their durability – as if using enough costly goop will keep water out. This is cap flashing mounted with screws through the top of the flashing – the most exposed, vulnerable location. The roofer claimed the screws were protected as he applied caulking before installing the screws, so that it would be a self-sealing connection. Note the ponding of water around the screw.



This picture was taken before construction was completed – corrosion staining is already evident on the flashing and screw. In addition, the screw created a depression, guaranteeing that water would pond against the fastener and, as soon as the effects of weather and sun took place, would create a reservoir for water to enter the assembly below.

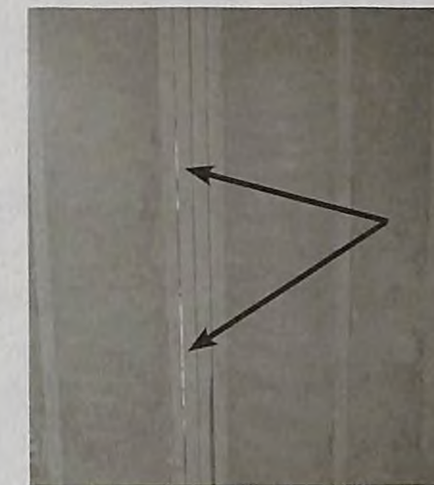
Thermal Bridging

There is a belief that with wood framing, the thermal bridging is not as severe an issue as it might be with more conductive materials such as steel framing. However, the impact can be significant.

This is a roof deck in a house still under construction. The roof deck is over an interior living space. The roof assembly is insulated with spray foam insulation so it is airtight. The thermal bridging through the I-joists can be clearly seen in this photo taken in the early morning in September, on a sunny day following a clear night during which the surface temperature of the deck fell much lower than ambient air temperature.

Air Sealing

There is a belief that if the whole house is insulated with spray foam insulation, the house will be airtight. Although spray foam insulation does contribute to air sealing the building envelope, there is no guarantee that the house will be airtight. When wood shrinks, it can open up gaps, so the built up framing members must be caulked to prevent these gaps.



In this location it is possible to see daylight between the studs. If the gap is too small to spray, then it must be caulked with a flexible caulking.

Where polyethylene is used to provide the air barrier, it covers the face of the framing, and this detail is addressed. ☼

Disaster Follow Up Information: Home Safety Tips

Following the devastating floods earlier this summer, the Alberta Department of Municipal Affairs has issued a series of safety tip bulletins. These fact sheets and brochures provide general information for building safety, personal emergency preparedness and fire and injury prevention. Although they were prepared directly as a result of the Alberta floods, they are good checklists for dealing with similar events anywhere, any time. They are written clearly, and can be useful for a homeowner as well as the professional.

Titles include:
- Private Sewage and Water Well Systems Recovery and Start Up After a Flood
- Gas Appliances and Flooding
- Electrical Tips for Returning to Your Home or Business After a Flood
- Elevators/Escalators Exposed to Flooding and Water Damage

Available for download at:
www.municipalaffairs.alberta.ca/codes_and_permits_safety_tips.cfm

Canadian Home Builders' Association

Technical Committee Research News

Solar Photovoltaic (PV) Systems Electrician Certification

The growing use of solar photovoltaic (PV) systems has created a demand for electricians that can work with PV systems. To address the need, the CSA has developed a certification program for PV systems electricians. The program was developed in conjunction with the National Electrical Trade Council (NETCO) and industry stakeholders to provide assurance that an individual possesses the competencies deemed necessary to perform the job function of a Solar Photovoltaic Systems Certified electrician.

The certification program has been developed in compliance with the ISO 17024 standard, which is the global benchmark for organizations operating personnel certification programs. It outlines the methods and procedures required to ensure the objective and unbiased assessment of a candidate's knowledge, skills and abilities.

Passing the certification examination will indicate that the candidate possesses the knowledge, skills and decision-making abilities necessary to practice the proper techniques to pre-plan, implement, configure, install, commission, troubleshoot and maintain solar PV systems. Solar Photovoltaic Systems Certified electricians will be periodically re-assessed to ensure they remain up-to-date on technical developments and industry changes.

The CSA website will contain a registry of electricians certified in Solar Photovoltaic Systems installations.

BC Building Code Ventilation Requirement Changes

The BC Building and Safety Standards Branch has put proposed changes to BC Building Code ventilation requirements out for public review and comment. Currently, the BC Building Code only requires the operation of a home's principal exhaust fan on an eight-hour interval cycle per day or continuous operation. The objective of the proposals is to improve the ventilation effectiveness in new homes.

Electric resistance heaters and hydronic heating such as radiant floors are prominent in BC. However, these types of heating systems do little to distribute air throughout the home. Today inadequate ventilation is showing up even in natural gas forced-air heated homes because minimum furnace efficiency standards have eliminated the natural draft venting system that was previously required and which provided some air change in the house through the open chimneys.

One of the key reasons for bringing outside air inside is to dilute the indoor pollutants for the health of the occupants. Without moving air (as provided by forced air systems) dilution can be uneven, especially in bedrooms. Bedroom doors are generally closed at night for privacy and persons occupying these bedrooms add moisture and CO_2 laden air into the confined space for up to 8 hours or more.

The proposed changes will introduce a minimum requirement for continuous operation for continuous exhaust, makeup air and improved distribution. One or more air intakes will be required to ensure the home has a steady flow of fresh air drawn in from dedicated opening(s), and require distribution of fresh air to bedrooms. The code will not be mandating central forced air systems or HRVs. There are several ways to accomplish fresh air distribution without conventional ducting.

The proposed changes were drafted with the Thermal Environmental Comfort Association (TECA) which is the BC-based residential heating, ventilating and cooling industry association.

The revised ventilation requirements will come into effect with the energy efficiency requirements for new homes in December 2014, leaving time for the industry to prepare.

The branch has also prepared seven schematics of acceptable ventilation systems. These cover:

- Small dwelling without forced air.
- Dwelling with forced air system.
- Dwelling with HRV and forced air system.
- Dwelling with HRV, without forced air system.
- RCV system drawing air from bedrooms.
- RCV system supplying air to bedrooms.
- MURBs without forced air.

For information:
www.housing.gov.bc.ca/building/green/energy/

National Building Code

Proposed changes to the 2010 National Model Construction Codes will be open for public review from October 15 to December 13, 2013 on the National Codes website. The purpose of this public review is to provide Code users and stakeholders with a detailed look at changes being considered for inclusion in the 2015 editions of the National Model Construction Codes and seek comment on each one as to whether it should be approved, altered, or rejected.

The proposed changes in this public review cover a variety of topics, including: mid-rise combustible construction; component additive method for determining fire resistance; stairs, ramps and handrails; accessibility; water use efficiency; ground motions (seismicity design data); energy efficiency for buildings (building envelope; lighting; heating, ventilating and air-conditioning; service water heating); air sound transmission; and exterior insulation and finish systems.

Missing Miele Product Test Data

German industry has acquired a deserved reputation for quality engineering and design.

Many German appliances are considered top-end luxury goods because of their design.

There is no doubt that German industrial products are well designed and constructed. However, it is interesting to note that while they claim great performance, some manufacturers will not provide performance specifications which allow consumers to assess equipment suitability.

Miele has a line of very attractive and expensive kitchen range hoods favoured by many designers, but they will not provide performance test data, like most other suppliers, who have their performance tested and listed by HVI (Home Ventilating Institute). HVI is the North American organization that tests and certifies the ratings of air delivery, power consumption, and sound for fans and heat recovery ventilation equipment. Their *Certified Home Ventilating Products Directory* lists accurate independent specifications and enables specifiers to do quick performance comparisons between equipment. The HVI directory is updated twice a year, and is available at *www.hvi.org*.

Miele identifies itself as a German manufacturer of the highest-quality domestic appliances in the world, providing an absolutely top-class household product. Further, they say that the customer "is at the center of attention". So it was a surprise to be told by their Canadian representatives that "all of our appliances including the ventilation hoods are tested by the Miele Factory Hood Engineers at the head office in Germany and they're all CE and CSA approved. Unfortunately, the test results are not publicized or provided to us." In other words, "trust us, but we're not going to let you have the information."

Although many people are happy to just have information about the size and look of the fan and aren't really too interested in the performance information, it is important for energy modellers, and anyone wanting to know the performance of ventilation equipment. A beautiful looking fan or range hood that doesn't move much air may not be what's required for a kitchen that's meant to be used, rather than just looked at. Similarly, if the fan is noisy, it will seldom be used. And when energy performance is a consideration, it is important to know the power consumption. ☼

Super Efficient New Homes in Penticton

Innovation in housing happens by trying new, carefully analysed technologies and following that up with monitoring after construction to ensure performance is to expectations and to learn for the future. This was the basis of a BC Ministry of Energy initiative in 2009, to build very energy-efficient, marketable homes that achieve a minimum EnerGuide 88 rating, primarily through passive solar design, superior envelope construction and high efficiency mechanical equipment.

A 'marketable' home was defined as one that is technically and financially feasible to construct, has a design and a market price that would be considered desirable by a reasonably broad range of consumers, and has a design that is replicable by builders and trades in BC. Homes with smaller-than-average overall floor space were encouraged, as this is a key element in decreasing energy demand.

South elevation of R-2000 house

An important point in the call for proposals was that the proponent had to obtain a signed commitment from project occupants to monitor the homes for the next ten years to do on-site reviews and access utility records for analysis.

One project recently finished is an eight-home project for the Penticton Indian Band. These homes are identical, 1,580 sq.ft. four-bedroom slab-on-grade homes designed by Allen & Maurer Architects and built by Ritchie Contracting & Design Ltd., both of Penticton. All of these homes are located with identical south-facing orientation for maximum passive solar gains, with substantial overhangs to minimize overheating in the summer. Five are certified EnerGuide 88, one unit is R-2000 certified, one is aiming to be LEED Platinum, and one is certified as a Passive House.

The R-2000 unit in the Penticton project conforms to the new more stringent 2012 edition of the standard (which sets the energy performance target at 50% more efficient than the National Building Code). It is also the first dwelling to be certified under the new R-2000 standard in the Okanagan valley.

The BC Ministry of Energy and Fortis (the gas and electrical utility in the south Okanagan) are planning to do detailed monitoring of these units. Since the demographic profile will be similar among all residents, with identical designs and orientation, the monitoring will offer a good comparison of performance between the homes meeting the different certification programs. ☼

Penticton Super Efficient Home Design features

R-2000 & ERS 88 houses
- Ceilings 12" structurally insulated panels
- Walls 8" structurally insulated panels
- Windows: triple glazed fiberglass
- Insulated concrete slab (R-12)
- HRV
- Heat pump
- LED lighting

Passive House Specs
- Ceilings 12" structurally insulated panels + insulation total nominal R-60
- Walls 8" structurally insulated panels + semi rigid fiber insulation - total nominal R-40
- Windows: Quad glazed fiberglass (but larger south facing windows)
- Insulated concrete slab (R-28)
- European HRV
- LED lighting

Smart Windows To Reduce Cooling

Nearly 40 per cent of the world's energy is used for the heating, cooling, ventilation and lighting of buildings. It is mostly the energy consumption for cooling that has increased rapidly in recent years – and demand will only increase with climate change.

Researchers at the Swedish Research Council are working on developing the second generation of smart windows, that use nanoparticles to regulate the heat transmission from the sun. They hope the new technology will decrease the need for air conditioning and thus a reduction in energy demand.

It has long been known that a window's transmittance of solar energy can be affected by thermochromic materials which automatically react to different temperatures (like a mood ring). Until now the problem has been that such materials have not had a high enough transparency to be used in windows.

Electrochromic technology is based on materials which regulate the windows' transmittance of sunlight and heat by using a weak electrical signal across the window. The electrical signal causes the window to be either lightened or darkened, or to gradually shift its permeability for light and solar energy according to a desired scale of light to dark.

The electrochromic technology, however, can only handle a certain degree of the solar energy. In order to achieve the best possible insulation against undesirable heating but still retaining the desired transparency for the windows, researchers are now developing a new thermochromic nanotechnology aimed at selectively reducing the sun's infrared radiation without affecting the transparency.

Researchers are looking at metal oxide nanoparticles embedded in thin polyester foils that can be integrated into the glass. The challenge has been to find and produce the right type of nanoparticles and then embedding the nanoparticles in the glass so that the material is evenly distributed across the surface. Preliminary results have been promising so far.

The research is being done at the Ångström Laboratory in Uppsala, Sweden. The research has already resulted in a technology that is about to be commercialised and produced on a large scale. ☼

Energy Answers

Rob Dumont

Is there a low cost, low energy technology that can provide cooling for houses?

I have used a window mounted fan to blow cool outside air into our bedroom in the late evening and through the night. We have used the fan for about 20 years now. A picture of the fan, which is mounted in a piece of quarter-inch thick plywood in a casement window, is shown in Figure 1. When at a lumber yard recently, I saw a similar fan for sale for about $40.

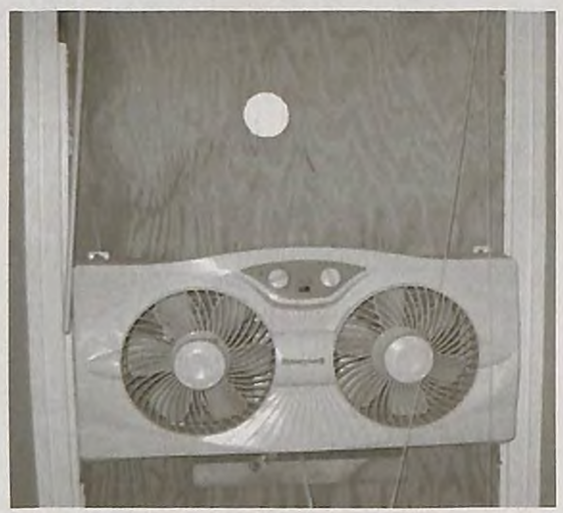


Figure 1. Honeywell Dual Fan mounted in a piece of plywood in a casement window as seen from inside the house. A photo of the fan as seen from outside the house is shown in Figure 2.

Figure 2. Outside view of the fan system for cooling the bedroom.

During rainstorms, the casement window is closed to prevent rain from entering. When the fan is running and drawing air into the house, other windows on the second floor of the house are opened so as to get air flow into these other rooms.

In Figure 3, a view of the north side of our house is shown. The fan does not stick out like a window-mounted air conditioner.

Figure 3. Outside view of the north side of the house. The window fan is mounted in the upper left window.

I modified the fan by adding an air filter on the outside to limit the amount of dust, pollen and airborne particles that enter. Although the window fan is mounted on the north side of our house, the window fan can be mounted in a window facing any direction.

We live on a relatively busy boulevard, and the fan helps to mask the noise from the street.

The reason that the fan works to cool the house is that the air temperature outside will drop after the sun goes down. Although daytime temperatures outside will go higher than 30°C (86°F) on occasion during the summer in Saskatoon, at night the outdoor air temperature will almost always drop below 20°C (68°F). This cool outdoor air makes for inexpensive cooling. On low speed the fan uses only 48 watts of electricity.

In the morning we turn the fan off and close the windows in the house to limit the daytime heating.

To further reduce the problem of overheating in our house, we have roof overhangs on our south windows to provide summer shading, and we have very few east- or west-facing windows. Large west-facing windows can be a strong source of overheating if there are no external shading devices on the windows. An unshaded 5-foot by 6-foot patio door facing west will dump about 6,000 Btu/hour into a house when the sun is shining. We also use

compact fluorescent and light-emitting diode lamps, and Energy Star appliances to reduce internal heat gains from electricity use.

The night ventilation technique using a window-mounted fan will not work in all climates.

Here are a few things to keep in mind when considering this technique.

- If the night-time outdoor temperature does not fall below about 20°C, the strategy will not work very well.
- Another difficulty with the technique is that it will not lower the humidity in the house. As Saskatoon has a dry climate, this is not a problem for us.

This cooling approach of using a fan to provide night-time cooling uses considerably less energy than a window-mounted air conditioner. The fan is also much quieter, less complicated and less expensive than a conventional air conditioner.

In parts of the U.S., whole house fans are sometimes used. The large fans, usually mounted in the ceiling of the upper floor, exhaust air from the house into the attic and draw air in through open windows. My aunt and uncle, who lived near Detroit, had such a fan in their house, which was built in the 1950s. Whole house fans are so powerful that they can backdraft chimneys, and thus should not be used in houses with atmospheric vented chimneys.

For more information on whole house fans, use your search engine to find "Whole House Fans, NREL." ☼

NRC·CNRC

Indoor Air Quality And The Respiratory Health of Asthmatic children

A field study investigating the impact of residential ventilation rates on indoor air quality (IAQ) and the respiratory health of asthmatic children in Québec City was recently completed by the National Research Council of Canada (NRC) and the Institut national de santé publique du Québec (INSPQ). The objectives of this study were threefold: to determine whether an increase in ventilation would lead to a corresponding decrease in the children's asthma symptoms; to correlate ventilation rates with IAQ; and to support research for determining health-based ventilation rates.

The three-year study showed that in the majority of homes, and particularly in children's bedrooms, ventilation rates did not meet the guidelines of the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). Through the installation of either a Heat Recovery Ventilator (HRV) or an Energy Recovery Ventilator (ERV),the ventilation rates were sufficiently increased to meet the guidelines. By pre-heating or pre-cooling the incoming air as required, HRVs andERVs enable an increased volume of outside air to come into the home, while minimizing the heating/cooling costs normally associated with natural or traditional mechanical ventilation.

In a large number of homes, the relative humidity (RH) was found to be too low in winter, which is a common problem in northern climates. Low RH levels are often associated with a negative impact on occupants' comfort and might also aggravate respiratory symptoms. Because introducing more cold and dry outside air in winter further reduces RH, low-RH homes were chosen for the installation of the ERVs (instead of HRVs) to increase the ventilation rate. The semi-permeable membrane of the ERV's heat-transfer core allows it to transfer moisture from the outgoing air to the incoming air, thus preventing the RH being further reduced in the homes.Figure 1 illustrates the effect of adding ERVs and HRVs on indoor relative humidity during the heating season (October-March) and shows that the installation of an ERV avoided the dehumidification of the home, otherwise associated with increased cold supply air rates.

Prior to the intervention, it was observed that the concentration of many pollutant gases was found to be elevated in homes with lower ventilation rates. This was also shown in the case of carbon dioxide in Figure 2, a marker for human activity that is often used as an indicator of inadequate ventilation when observed at high concentrations. There was also a marked seasonal variation in the concentration of several volatile organic compounds (VOC), with many of them being more elevated during the heating season when the ventilation rates in the homes were generally lower. Compounds which are released from building and consumer products were found at more elevated concentrations in the summer because their emission rates increase with temperature. This was the case with formaldehyde, which is a known irritant and can potentially trigger asthma. Its concentrations were observed to be much higher in summer. In summer, the formaldehyde concentrations in roughly two-thirds of the homes were found to exceed the Health Canada guideline of 50 µg/m³, while only one-third exceeded the guideline in the heating season.

The ventilation intervention was successful in that it led to a near doubling of the ventilation rate during the heatingseason in the homes receiving an HRV or ERV. The interventions were also successful in that they led to a statistically significant reduction in the concentration of the number of IAQ relevant parameters. Following the intervention,the median concentrations of carbon dioxide and formaldehyde decreased by 14% and 32% respectively during the heating season for the homes receiving an HRV or ERV. There was also a notable decrease in the concentration of airborne mold spores throughout the homes. As a result of increasing the ventilation rate, all of the homes were subsequently able to meet Health Canada's formaldehyde guideline during the heating season and there was a significant reduction in the number of homes exceeding the guideline in summer. Data on the improvement of respiratory health through this intervention will be available in the fall of 2012.

This research activity was a three-year, multi-partner project between the NRC, INSPQ, the Centre Hospitalier Universitaire du Québec (CHUQ) and Canada Mortgage and Housing Corporation (CMHC). The Ministère de la Santé et des Services sociaux du Québec and Health Canada were also partners. INSPQ was responsible for coordinating the activities in the field, recruiting the participants and monitoring the health of asthmatic children. NRC was responsible for characterizing the environmental conditions, especially the IAQ and the ventilation scenario. ☼

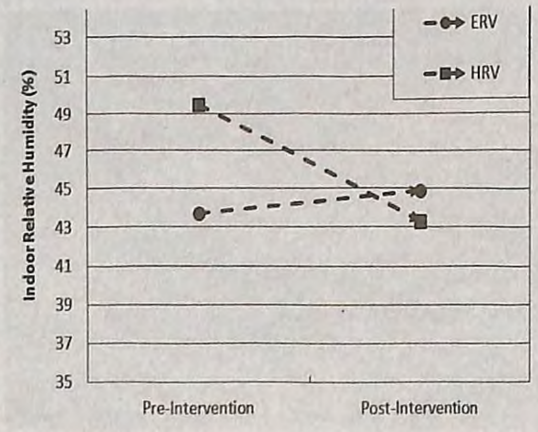


Figure 1: Average relative humidity observed during the heatingseason both before and after the installation of either an ERV (blue) or HRV(red) in the homes participating in the ventilation intervention.

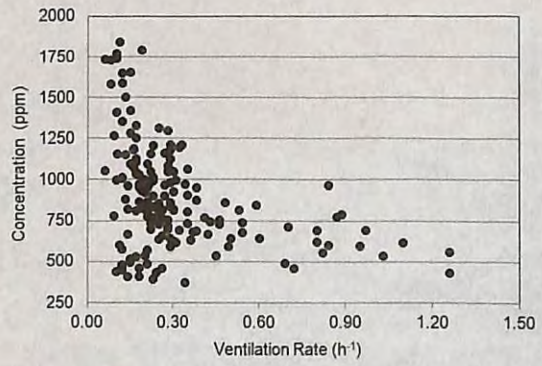


Figure 2: Concentration (ppm) of carbon dioxide measured during the heatingseason in the participant homes prior to the intervention as a function of the ventilation rate.

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Study design

Asthmatic children were recruited through the Centre HospitalierUniversitaire du Québec. The homes were visited twice during the heating season and once in summer, both before and after the intervention, for a total of six visits. At the end of the three visits during the pre-intervention phase, HRVs or ERVs were introduced in 50% of the homes selected at random, keeping the other 50% as controls. The same set of parameters was measured during the three post-intervention visits. NRC staff was responsible for measuring a comprehensive set of IAQ-relevant physical, chemical and microbiological parameters.

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